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TALES OF THE FIRST ANIMALS

By EDITH B. WALKER

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by

EDITH B. WALKER

WITH THE COLLABORATION OF

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ACKNOWLEDGMENT

For these pictures we have copied,
We extend our thanks to all.
The American Museum's
Paleontologic Hall,
To Pirsson and to Schuchert,
To Wiley and to Ginn,
To the Albany Museum,
To LeConte and Chamberlin,
To the motion picture magnates
Who once made a dinosaur,
We acknowledge our indebtedness
To these and many more.

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CHAPTER I

THE TIME AMONG THE STARS

THE ASTRAL EON

Thousands of millions of years ago,
Before the world began,
There was neither air, nor land, nor sea;
There was no such thing as man.

The Astral Eon that age is called
By the men who study the world.
The Earth was a ball that swung in space
Where vapors and gases curled.

Meteorites from the heavens fell,
Bringing tales of the worlds on high
And the aimless atoms arranged their lives,
In the sea and land and sky.

THE TIME AMONG THE STARS

Thousands of millions of years ago the sun was shining every day and the stars were twinkling each night, but there was no earth. Two long comet-like arms spun around the sun in the paths that the earth and planets follow today.

These arms were formed of particles of dust and tiny planets made of the same gases and rocks and minerals as the sun itself.

The arms looked like the tails of a kite streaming out in spirals with the sun in the center. In each spiral, knots of tiny planets gathered together and formed separate groups.

In time these groups became the nine planets that revolve around the sun. One of them was our Earth.

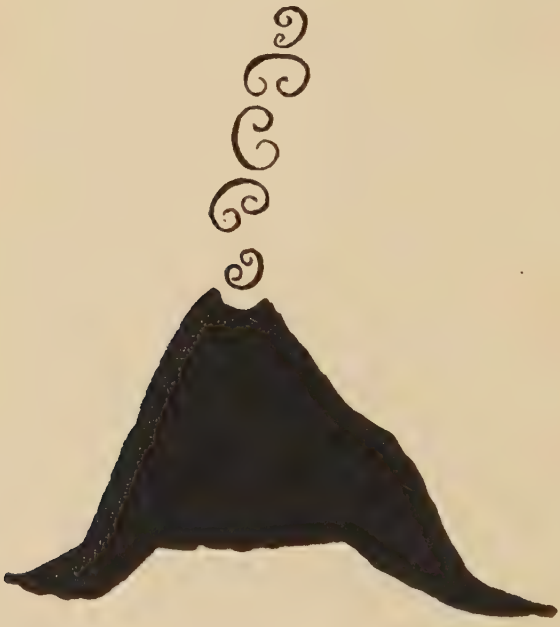
The minerals the Earth was made of attracted many of the falling stars. These stars are called meteorites. Many meteorites must have fallen on the surface of the Earth since it first began its journey through space.

As they struck the Earth some of these falling stars drove deep holes in the ground. Others burned as they fell or were crushed to powder.

Large pieces of meteorites have been found on the fields or mountains. Some have been taken to the museums where they can be seen by every one.

They are made of metals and rock and are very hard. Some are as full of holes as a Swiss cheese. The holes were worn or burned in the rock as the meteorite rushed flaming through the air.

The rock and metal and dust and gas that formed the earth were squeezed together as they swung around and around. The rocks knocked and pushed



A Volcano

against each other as if they were all trying to get to the center at once.

Some rocks that were softer than others were melted by the weight and pressure of those above them. This melted rock moved around in the interior

of the Earth until it found a crack. Then it pushed its way up through the crack towards the surface.

If the pressure was very strong the molten mass would rush up through the hole, blowing everything before it in the air. It carried gases and steam and a red hot liquid called lava.

The lava spread over the surface and when cool turned to stone. The gases blew away. The steam rose in the air and then fell back as rain on the surface of the Earth.

The steam and lava left empty spaces in the rock as they tore their way through. The rocks on the sides of the openings were melted themselves by the heat.

Hot metal followed the lava and filled the empty spaces. It forced its way into every seam and crack that was left open. These lines of metal running through the rock form the veins of the gold and silver and copper mines that are being worked today.

When steam and lava and gas burst through the Earth this way it is called the eruption of a volcano.

This name was given to it by the Romans. They had a god named Vulcan. Vulcan they thought lived in the center of the Earth and made armor. When they saw the smoke and flames curl above the volcano's mouth, they thought that Vulcan was hammering on his anvil and making the sparks and metal fly in the air. And that was how a volcano got its name. But the beginning of the world was many millions of years before the days of the old Romans.

There was no life at all in the world when the Earth first began. Nothing but barren rocks and rushing rain storms and a hungry ocean that washed over the rocks when it had a chance.

Down in the center of the Earth great masses of rock were pushing and grinding against each other. Up on the surface the melted rock came pouring from

THE CHANGING CELLS

the mouths of the volcanoes. Layer after layer of lava spread upon the land. Circles of ashes and lava piled high around the mouth of the volcanoes.

Mountains began to rise. Earthquakes shook the surface. Dust from the volcanoes settled on the land. Rocks broke up into gravel. Rain washed the dust and gravel down to the plains. Particles from the

sea were washed back upon the land and the beginning of the soil was made.

The sea moistened the edges of the land. The air blew on it and stirred the dust. The damp climate nourished it and one day on the edge of the shore something stirred that was alive.

It was a tiny cell, so small that it could not be seen. Slowly there came to be more and more like it. They were so small that even thousands of these atoms did not look like anything but jellied mud.

But they were alive. There were great folds of mineral earth beneath, the waves and the depths of the sea around, and the miles of air above them. And of all of them, the fragile little jelly cells were the only things that were alive.

All around the edges of the bay the jelly spread. Thousands daily were added to the original colony. They basked in the sunshine when it made its way through the thick air. They drank the warm water when it washed over them and when the warm fog settled down on them they slept and grew and spread farther and farther along the shore.

When their numbers had reached many hundred thousands, some of the little jelly cells began to grow more active than others. These active ones changed and improved and broke away from the simple jellies, forming new groups of cells.

These new groups soon looked quite different from the first cells. They had branches. These branches were the simplest kind of heads and tails and feet.

The groups with branches were the beginning of the families of all the plants and animals.

It is millions of years since our world first began, yet floating about the water's edge can still be found tiny jelly cells like the first ones that started life upon the earth.

CHAPTER II

THE DAWN OF LIFE

THE ARCHEOZOIC ERA

The Archeozoic Era marks the dawn of life on earth,
The erosion of the mountains by the sea—
The making of the granites and the marbles and the quartz,
And the ocean flowing where the land should be.

The Archeozoic creatures were of very simple growth,
There were jelly fishes living near the shore.
There were molds upon the marshes and lichens on the rocks,
And seaweeds growing on the ocean floor.

THE DAWN OF LIFE

Millions of years had passed. The great lava fields had been worn down to the level of the ocean.

The frost got into the cracks and split the rocks. The air ate into their surfaces and crumbled them to sand. The wind blew the sand against them and wore them away. Then the rain came down, washing all the loose particles into the rivers and the rivers carried them to the sea. The sea dissolved what it could and what was left settled on the bottom.

It took a long time to do this for the rocks were very hard, but in time the air, the frost, the wind and the rain broke them up and washed them away.

The sea beat against the edges of the shore and washed it away bit by bit. The tides swept sand upon the beaches. Everything was leveled.

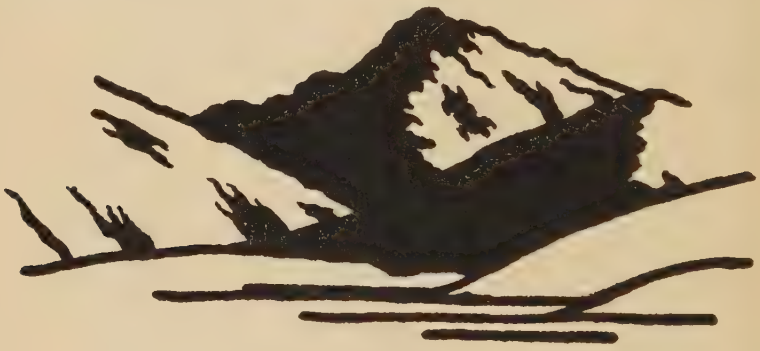
The materials from the mountains filled the ocean's bed. The water rose and spread over the land.

For years the land was covered by the ocean. In the center of the Earth the rocks shifted about. In time the ocean bottom sank. The sea receded again and the land rose.

New mountains came to the surface. They were covered by the clay and sand and ooze that the sea had washed over the land. It dried in the sun and became new rock.

The particles of clay made rocks called shale. Shale pressed very hard becomes slate. Slate splits into smooth thin layers. It is used for roofing houses and for paving stones. It is used for slates in school.

The sand became sandstone. The lime became limestone which, under pressure, turned to marble. Then there were rocks of granite, a coarse grained stone mixed with colored crystals. Some granite is gray, some white and some rose color. Granite is one of the strongest stones. It is used for buildings and monuments.



THE WRINKLED MOUNTAINS

Up from the center of the Earth melted rock kept pushing its way through the cracks. Much of it welled slowly up to the surface or forced itself sideways between other layers of rock.

The old Plutonic rocks were formed this way. They lay under the surface for ages. Then in the great Earth changes they were raised up into high plateaus. The rocks that had covered them up were worn and washed away.

The Plutonic rocks are found in the eastern part of Norway and Sweden, the southern part of India, western Australia, the highlands of Brazil and Central Africa. In Canada the Plutonic rocks form the great Canadian shield.

Old and hard as these rocks are they too wear down and decay. Up in the air their outer edges are slowly crumbling. Even the hardest stone decays when it has been exposed to the weather long enough. A change in climate often affects the rocks. The decay of Cleopatra's Needle is a case of this kind.

Cleopatra's Needle was an obelisk that had been standing for three thousand years in the dry air of Egypt. Not very long ago it was brought to New York and set up in Central Park. After a few years in that moist climate the outside began to crumble. Now it has been covered with a coat of paraffin to keep out the damp air, in the hope that it will last for three thousand years more.

There was nothing to save the old rocks from decay where they were at the surface. But sometimes the seas covered them when they washed over the land and spread thick mud on the rocks underneath.

In other places the rivers brought so much gravel and sand down from the mountains that the rocks on the plains were buried beneath it. Near the volcanoes, streams of lava spread over the land and formed a covering many feet thick.

In this way some of the rocks of the Archeozoic Era have been saved. Today, in mining, these old rocks

are found covered by many layers of stone made in later ages.

On top of the Archeozoic rocks lie the rocks of the next Era. That time is known as the Age of Iron Making. The Greek name for it is the Proterozoic Era, which means the Era of Former Life.

A Modern Jellyfish

Back in the Age of Iron Making, the iron ore in the mines around Lake Superior was formed. The iron mines of Sweden were made then too. All over the world are beds of iron ore which were made at this time—about a billion years ago.

Besides the iron, large deposits of nickel and silver and copper are found in the rocks of the Age of Iron Making. All through Canada are mines of this time

that are famed for their rich veins of ore. The Porcupine gold mine is one of them. The Nippissing copper mines and the Cobalt mines, rich in copper and silver, are others.

Down through the United States stretches this belt of metal deposits. From Lake Superior, Michigan, Minnesota and Montana it goes through Wyoming, Colorado, Utah, Nevada, Arizona and New Mexico. Iron, copper, gold and silver were stored away in these rocks. They were buried far enough below the surface to last until the coming of man.

While the great mines and mountains were being formed, little primitive things were growing and spreading about the Earth.

It was thousands of years since the first of the jelly-like atoms began their life on the water's edge. They had changed greatly from the first simple jelly cells. Soft chain-like forms, sponges and spine-covered balls and seaweed were living in the water.

As the ages went on, one group began to grow a shell for covering. Inside the shell was the live creature. These were called Mollusks (shell fish). The oysters, snails and clams are mollusks.

Another group as it changed sent out small leaves and roots. This group formed the plant family. At first the plants were simple seaweeds in the water and lichen on the rocks. Rich beds of clay and lime washed into the spaces between the rocks. In these beds toadstool-like plants began to grow.

Where the rivers brought the fine clay down to the

sea, the seaweeds crept up on the shore. They took root out of reach of the tides and became land plants.

There were also jelly-like cells that moved rapidly through the water. They looked like worms and wrigglers. They were the beginning of the family of fishes.

SEAWEED

Some of the fishes left the water for the land and crept about in the marshes. In place of the fins of the fishes, legs began to grow. These were the first of the Amphibians, creatures that lived like the frogs, half on water and half on land.

From the Amphibians came the Reptiles, once a great race. The snakes and lizards, turtles and alligators are the reptiles that are alive today.

Some of the reptiles changed from cold blooded creatures to warm blooded ones. They grew feathers.

Courtesy of the American Museum of Natural History

A Drop of Water as Seen Through Dr. Roy Waldo Miner's Microscope

Their front feet folded up against their sides and became wings. Horny lips became beaks and the hind feet grew claws that could take hold of the branches of the trees. These were the parents of the Birds.

Other cold blooded reptiles became warm blooded and their tough skin and scales changed to hair or fur. From these came the cats and dogs and sheep, the monkeys and all the wild animals. They are called the family of Mammals.

It was many thousands of years after the Era of Iron Making that these creatures lived. They all came from the first little jelly cells that floated about in the mud. The ones that changed were those that could move about and grow to suit the place they lived in.

A great many years were needed for every change. From jelly cell to mollusk, from mollusk to fish, from fish to amphibian, amphibian to reptile, and reptile to bird and mammal took millions of years.

And for millions of years before even the jelly cell began to live, the rocks and water and air had been working together to form the world.

CHAPTER III

THE ERA OF FISHES

THE PALEOZOIC ERA

The mollusks, the fish and the coal,
The corals, and mosses and trees,
The ocean engulfing the whole,
The Age Palaeozoic brings these.

The Palaeozoic advance,
Puts the fish on the front of the stage.
The animals, taking no chance,
Wait the dawn of a much later age.

THE ERA OF FISHES

Years and years passed and another era began. It was so long ago that it was called the Era of Ancient Life. In Greek, "Paleo" means old, and "Zoic," life, so this ancient time was called the Paleozoic Era. Another name for it was the Age of Fishes.

The Paleozoic Era was the time when the corals built great reefs in the ocean. When all kinds of shell fish were floating about in the waters. When the fish grew greater than the shell fish and filled the rivers and sea. When the great coal forests grew on the marshes and the amphibians crept about in them.

The rocks of that time are filled with fossils of fishes and sea shells and corals and sponges and other creatures that lived in the water.

A fossil is formed when a shell settling in a layer of clay or sand or limestone is covered by another layer. In time the shell is absorbed but its imprint is left in the rock. On splitting the rock open, a perfect mold of the shell is found. It is the fossils that tell in which age the rocks were made.

The men who study the Earth are always hunting for fossils and new layers of rock. To every new found layer of rock they give a name and date. From those names other men can tell just when the rock was made.

The Era of Ancient Life lasted for more than six hundred million years. This was such a long time that it has been divided into shorter periods called ages.

Among the most important are:

The Cambrian Age, when the fossils first show that there was a great deal of life in the sea.

A Silurian Scorpion

The Silurian Age, when the shell fish were the ruling race and filled the ocean.

The Devonian Age, when the fishes took their place in the ocean and swam in the broad rivers that drained the land.

The Carboniferous Age, when the plants became trees which grew to great heights, and dying, fell over in the marshes and were changed to coal.

The first part of the Era of Ancient Life was called the Cambrian Age.

Cambria is an old Welsh name for Wales. It was in Cambria that an Englishman first found the rocks that were made in Cambrian times. In Wales and Brittany these rocks are two miles thick. They are folded and crumpled into great crags and rugged mountains.

In other places in Europe the Cambrian rocks are very thin. In North America the rocks are nearly as thick as they are in Wales.

THREE TRILOBITES

In some places in the United States they are squeezed together in folds. In others, they are level. Usually, they are covered up by later rocks, but in some sections they can be seen on the surface.

In Wisconsin, level Cambrian rocks stretch over the country for many miles. Then they dip down and disappear covered by the layers of rocks that were made afterwards.

They are seen again in Missouri and Texas, and Canada and New York. When they come to the sur-

face in New York, they stand right up on end instead of lying flat.

In the Cambrian rocks are fossils of sea worms, lamp shells, trilobites and simple corals. There are many more fossils in these rocks than have been found in the rocks of any age before the Cambrian Age.

The lamp shells were small clam-like shells, sometimes plain and sometimes very much scalloped.

THE CRAB-LIKE CRUSTACEAN

The trilobites were found in all the rocks. There were a great many different kinds. They were called crustaceans, which means they have a crust or shell for a covering.

One shield of shell covered their heads and another their tails. Their backs were covered with jointed sections of shell. When attacked they could either roll up in a ball or run away. The jointed shell that covered them made a complete armor.

They are related to the lobsters, crabs and shrimps of today.

It was the fossils of all these creatures that made the Cambrian rocks so different from the rocks that had been formed in earlier ages.

In the next age, the Age of Shellfish, the whole ocean was filled with swimming shell-covered creatures.

CHAPTER IV

THE AGE OF SHELLFISH

THE SILURIAN AGE

The Age was Silurian,
The mollusks reigned supreme.
There were coral reefs and trilobites and crustaceans;
There were seaweeds on the sand,
There were starfish floating free,
And the whole world lived in the waters of the sea.

The Age was Silurian,
The ocean called a halt.
The inland seas evaporated, leaving beds of salt.
There were mollusks on the rocks,
There were mollusks floating free,
And the whole world lived in the waters of the sea.

THE AGE OF SHELLFISH

The sea during the Silurian Age had collected a great deal of sand and lime and mud and left it on the land. Many shells of the family of mollusks were caught in this mud and became rock fossils.

The sea was filled with mollusks and seaweeds and corals and starfish and sponges. They grew in beds of sand and around submerged rocks and in fresh water and salt water.

Clams grew whose shells were two feet wide. There were living then all the early relatives of the conch shells, the periwinkles, and the scallops.

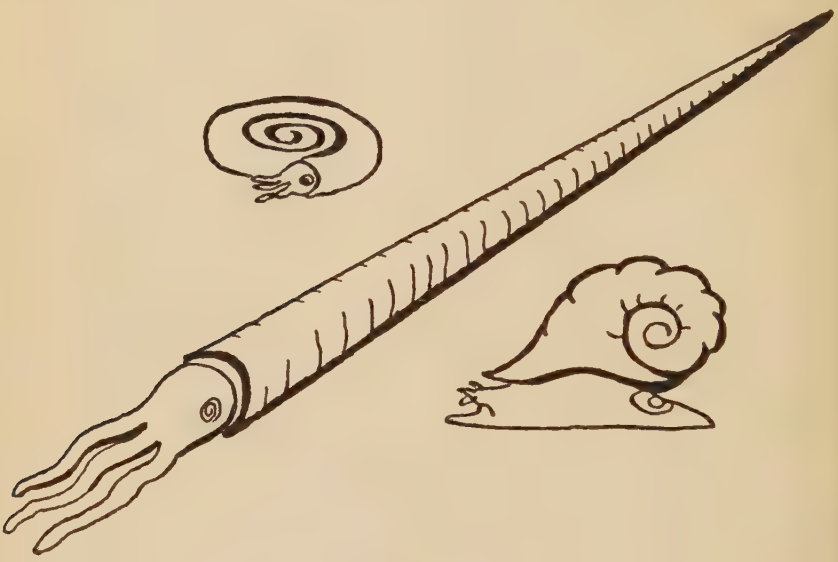
The largest mollusks that lived in the age of shellfish were the Orthoceras, creatures that lived in a long, straight shell like a telescope. They caught their food with their many arms which grew out of the larger end. The largest of these were fifteen feet long. Others of the same family grew no longer than a pin.

There were many trilobites living in the age of shellfish. In the rocks are fossils of spiders and scorpions. The spiders and scorpions are the earliest air breathing animals that have been found. Like the trilobites, they can roll up in a ball and lie still when attacked.

Besides these, there were sea anemones, sea worms

and barnacles among the crowds that filled the Silurian seas.

Among the other creatures that had developed from the jelly-like atoms were the coral polyps. Tiny things shaped like a corn flower. Though the stems on which they grew branched and budded like a tree,



Mollusks

the polyps were animals. They lived on the sea water they drew in through their mouths. The lime in the water was left by them on the coral branch on which whole families of the polyps lived. As the polyps on the upper part spread out in branches, the lower ones died and the lime on which they had been living became a part of the coral reef.

During the Age of Shellfish the corals were busy

building barrier reefs and islands in the shallow inland seas and along the edges of the shore.

The reef building corals never lived in water more than six hundred feet deep. They only grew in clear sea water, never at the mouths of rivers or where there were muddy currents.

A Coral Branch

As the seas spread over parts of the continents which are today dry land, many coral reefs were built. Then the sea sank back to its ocean bed and the coral reefs were left far inland.

These coral polyps did their share in changing the shape of the land. They built barrier reefs around the

volcanic islands in the ocean, making them larger. They built islands of coral where none had ever been before. They built large reefs in the shallow inland seas. When the seas that covered the land subsided, the coral reefs often were pushed up by the changes in the earth and became mountain ranges.

At the end of the Age of Mollusks the seas retreated from the land and the lakes and rivers began to dry up.

The ocean left great lakes of salt water on the land. These evaporated, leaving vast beds of salt behind them. From these salt beds and the salt springs that are near them come our rock salt and table salt.

The salt in the sea is washed down from the land. The rivers wear away the rocks and carry to the sea sand and gravel, clay and lime and salt.

The shellfish and the corals take up the lime. The clay settles on the bottom, but the salt is dissolved in the ocean. The faster the water evaporates, the saltier it becomes. When all the water dries up the salt crystals are left.

In Italy deep pits are dug near the seashore. They are filled with sea water and then the outlet is closed. The water evaporates and the salt is left in the pits. This is the way Italy gets her salt. The Government owns the salt beds and a heavy tax is put on any salt brought in from outside the country.

There were many kinds of water life in the oceans of the Silurian Age. The climate was probably mild for there were mollusks and sponges and corals in the sea. All creatures that live in warm water.

At the end of this Age, the fish were beginning to appear in the lakes and rivers. They were increasing in size and could swim great distances. Some of the

Courtesy New York State Museum

SEA LILY AND SHELLFISH

fish had scales as strong as armor. They were making ready to take away from the mollusks their position as rulers of the sea.

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CHAPTER V

THE AGE OF FISHES AND OLD RED SANDSTONE

THE DEVONIAN AGE

In the Old Devonian Age
The fishes came to their prime.
They swam in the lakes and bays
And the rivers of that time.

They were large as a baby whale,
They were small as the tiny bait,
There were spiny sharks and ganoids bright,
There were fish with armor plate.

They swam up into the streams,
Away from the salt of the sea,
As the ocean rose and covered the land,
And the tides ran high and free.

The sea sank back to its shore,
The sun rose high in the heaven.
And baked the silt that was left to a rock,
The Old Red Sandstone of Devon.

THE AGE OF FISHES AND OLD RED SANDSTONE

In the Devonian Age the plants were spreading all over the earth. They had started life in the water and slowly learned how to grow on land.

The land plants spread by means of powder-like seeds that were blown about by the wind, or by roots that sent out runners as the strawberry vine does now.

The deeper the plants could send their roots down into the rich earth the taller they grew. The lichens and mosses growing on the bare rocks never grew very large. The seaweed fed by the rich salts of the ocean were as large as some of the tall tropical ferns.

Under the water the colors of the seaweed were very beautiful—red and green and brown and yellow and tan. They floated back and forth with the waves. When a storm rose the seaweeds were often torn apart and thrown on the seashore far out of reach of the tides.

The sun dried the seaweed on the shore and it crumbled to bits. There the salts and iodine and other parts of the seaweed sank into the sand and made it rich. Coarse reeds and little running plants began to grow on the beach, just out of reach of the waves.

The plant had one great advantage over the animals. It did not have to move about in search of food.

It had to have water and sun and air and enough earth to hold and feed its roots. The more fertile the earth the bigger the plant grew.

Of course there was not much rich soil on top of the mountains in those days. The mountains were great rocks whose edges were crumbling slowly under

Courtesy of the New York State Museum

IN THE DEVONIAN SEA

the washing rains, the heat of the sun, the force of the winds and the cracking of the frost.

On the other hand, in the river valleys there were layers of fine particles of earth that had washed down from the mountain tops. These valleys were ideal places for land plants to grow. Even now looking over the country from any height the river valleys can

lways be traced by the broad line of rich green that utlines them.

In one of these valleys the plant had found foot-old. At the time the fish started to grow bigger than he mollusk, the plant and its family were growing rom lichens and mosses to giant trees. There were erns, horsetail rushes, giant ground pine and fir trees.

The roots of the trees held the moisture in the earth nd released it gradually. This helped to keep the ivers full of water. They were no longer freshets run-ing like torrents after every rain-fall and carrying all he water off at once.

There was a great deal of rain and a great deal of loudy weather. Perfect climate for the fish. So much ain made high water in the rivers and in many places hey spread out and formed lakes.

The lakes and rivers were filled with fish that were uite different from those living in salt water. Many ossil bones have been found of the fish that lived in the Devonian Age.

The insects were flying about and falling into the vater or skimming over its surface. These and the vater plants were food for the little fish. The bigger ish ate the minnows, wrigglers and other small water reatures and the large fish ate each other.

The warm damp climate made the plants and nsects grow. The fish in the lakes and rivers increased n numbers with plenty of food to eat and plenty of vater to swim in.

Everywhere along the valleys of the Devonian rivers are found the fossil skeletons of the fishes.

The first of these fish had scale-like armor and soft bones. Later they discarded the armor and their back bones became hard and ran down to the tip of their

Armored Fish

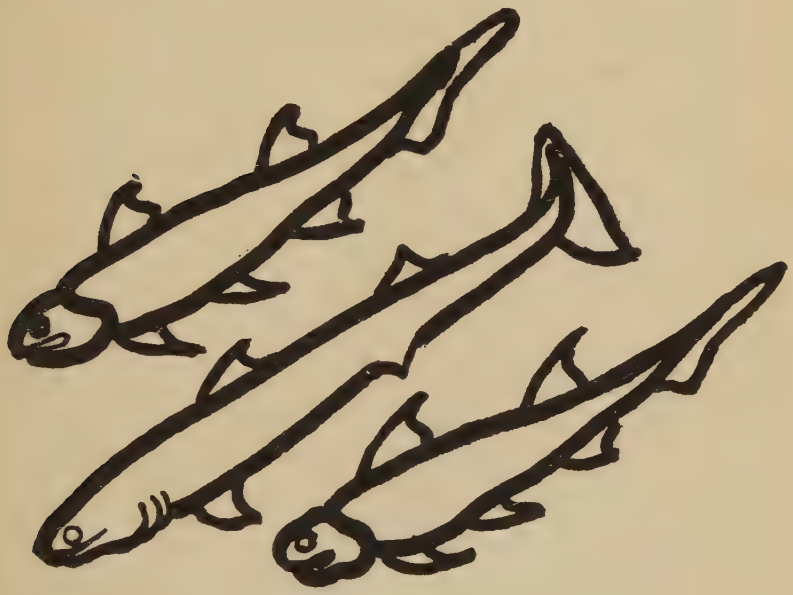
tail fins. In modern fish, the back bone stops at the beginning of their tails.

The fish were the first of living things to have back bones. They had no necks. The armored fish had thick, bony plates covering their heads like a shield. Most of them were small; about six or seven inches long.

There was one large kind of fish with armor that was twenty-five feet long. They were called the Ter

rible Fish. They had powerful jaws for crushing and tearing their food. Their fossil skeletons have been found in the black mud of New York and Ohio.

The sharks were all sizes. Some were twenty and thirty feet long. There were three hundred kinds of sharks that lived in the Devonian Age.



Ancient Sharks

Some had pointed spines on their backs and sides. Other sharks had broad flat teeth known as cobblestone pavement teeth. With these they crushed the shells of the mollusks.

The ganoids were fish with enamel covered scales, like the enamel on teeth. Their name comes from a Greek word meaning bright. The sturgeons and the garpike are descended from the ganoids.

When the climate became drier and the rivers grew too small to support the numbers of fish that were in them, some of these fish were driven to the sea. They became accustomed to it there and throve as well as they ever did in fresh water. Others, sooner than breathe the heavy salt water, learned to breathe air. They became ancesters of the lung fish who could breathe both in water and on land.

Some of the descendants of the lung fish live in the Nile. At night these fish leave the water and travel over the damp sand and grass for three or four hours, coming back to the river at sunrise. They use their fins and tails in place of legs.

In the Devonian Age the fishes were the great ruling race. Just as the mollusks had been during the Age of Shell Fish.

During the Devonian Age as the rivers spread over the land, they washed down great quantities of red sand. This deposit is known as the Old Red Sandstone. Because rocks of this age were found in Devonshire, England, it gave the Age of Fishes its name—the Devonian Age.

CHAPTER VI

THE AGE OF COAL

THE CARBONIFEROUS AGE

It was in the Carboniferous Age
The trees grew in the swamp,
The sun shone with a tropic heat,
The ground was soft and damp.

The trees and ferns were giants then,
Tall moss grew in the shade.
As the forests died they were carbonized
And the beds of coal were made.

THE AGE OF COAL

At the end of the Devonian period the Age of Coal began. Much of the land that had been submerged under the ocean was raised to just above the sea level. There was a great deal of rain and an almost tropical heat. The climate was so warm that ferns and tropical evergreens grew near the Arctic circle.

Before the great coal forests began to grow, the rivers and seas spread layers of sand and clay over the land. Some of these layers made the rock that is known as Millstone grit.

This rock had a coarse grain and was used to make millstones. All the thick round millstones that ground the flour in the old mills were made of this rock.

In the rich swamp land at the mouths of the rivers the plants sprang up and in the tropical climate they reached great heights.

The ferns grew to be trees, twenty and thirty feet tall. The little mosses that are now used for Christmas wreaths and called ground pine, or Lycopodium, then were fifty feet high.

Another moss grew to one hundred and fifty feet. The horsetail rushes of the meadows measured thirty feet or more.

There were giant conifers, conebearing trees, like

the sequoias and redwoods of California. The larch and cypress, the pines and spruces are modern conifers.

There were trees like the Ginkgo, the sacred maidenhair tree of India. The Ginkgo has a bark like a beech tree and a leaf like a maidenhair fern. For at least three thousand years it has been known in the history of India.

Trees of the Coal Age

For many millions of years or more, its fossil branches and leaves have lain hidden in the coal beds of the world.

The ferns and reeds were constantly dying and falling in the swamp. The big trees probably grew

faster than they do now. Just as today the forget-me-nots in California grow as high as the second-story windows.

At all events tree fell upon tree with the ferns and leaves and giant mosses falling between them. The water saturated the wood and the oil in its fibre kept it from decay.

After the fallen swampwood had accumulated many feet in thickness the ocean began to creep inland again. It washed the sand ahead of it and spread it over the beds of fallen trees. In other places the rivers spread out and covered the top of the swamps with a layer of clay.

Then other deposits were spread over the coal bed —sandstone, shale and iron ore.

Later the swamp lands rose again from the water. New forests sprang up, fell and were covered, and another coal seam would be formed.

The weight of the different layers of sand and clay resting upon the coal swamp squeezed the trees down to a tenth of the thickness of the fallen forests. A coal seam five feet thick means that at least fifty feet of fallen wood lay on the surface of the swamp when the water began washing sand and clay over its surface.

The water in the swamps preserved the trees. The weight of the rocks above pressed on them and hardened them into coal. Where the coal remained spread out in flat layers it formed soft coal. Soft coal is easily broken and gives off a heavy sooty smoke when it burns.

Where the coal seams were crumpled up by the wrinkling of the earth the pressure and heat of the crumpling made it hard coal. This is called Anthracite, and because it burns with very little flame or soot, it is the favorite coal for household use.

Courtesy of the New York State Museum

SPONGES IN THE SEA

The softest form of coal, or carbon, is graphite. This has been pressed and heated so much that it will no longer burn. It is possible that heat from a nearby volcano would turn coal to graphite. It is graphite from which lead pencils are made.

In mining the coal the outlines of the fruit and leaves and branches have been found preserved in the coal. The miners sometimes uncover whole tree trunks in such a perfect state that the tree can be recognized from the bark. Often the roots of the tree standing in the original bed of clay have been found.

Coal beds were also formed in later ages. Some of it is as good as any made in the great Carboniferous Age. Some is an imperfect brown coal and is called lignite.

Sometimes coal is called "black diamonds" because diamonds are made of the same materials as coal. The carbon that makes the coal has been so changed by heat and pressure that it is turned to crystals. The edges are so hard that they will cut glass.

It is not in the coal mines that diamonds are found. In India and South America they are taken from the gravel of old river beds.

In Africa the diamond mines are in deep wells of stone called pipes. They lead down into the earth from a shallow pit, like the crater of a volcano. The pipes are columns of hard rock called blue stone. The shafts of the great African diamond mines are in these bluestone columns. These columns are all that is left of very old volcanoes.

The water rose and fell in the swamps of the coal age. Some of the fishes were washed on the marshes and forced to breathe air instead of water. As they flopped about, their useless fins began to turn to feet. Their front feet had five fingers and their hind feet five toes.

These animal-like fishes were called amphibians. When young, they lived in the water but when grown they wandered about the swamps. The frogs, toads and salamanders are modern amphibians.

Some of the first amphibians had large clumsy

heads. They had one eye on each side of their heads. On top was a third eye. Clumsy as they were, it must have been hard for any insect to escape their three eyes.

There are reptiles living today that have the same third eye on the top of their heads. They cannot see with it, for it is only a blind eye. The pair of eyes in front do all the work.

AMPHIBIANS

The strangest thing is that in the brain of all animals, and even man, there is a place that corresponds to the third eye of the amphibians who wandered in the swamps of the coal forests so long ago.

CHAPTER VII

THE ERA OF REPTILES

THE MESOZOIC ERA

The reptiles Mesozoic were stupid silent stoics.
They died the death of martyrs when the recent times began,
But before the sea washed over
All of England north of Dover,
Leaving cliffs of chalk behind it,
They were rulers of the land.

THE ERA OF REPTILES

The Era of Reptiles was called the Mesozoic Era. It was the time between the Era of Fishes and the Era of Mammals. Because it came between them, it was called Mesozoic. "Meso" means middle, and "zoic," life.

The Era of Reptiles is divided into three periods: the Age of the Three Layers, the Triassic Age, when the reptiles began to develop;

The Age of the Jura Mountains, the Jurassic Age, when the reptiles were at their prime;

The Age of Chalk, the Cretaceous Age, when the great chalk beds were laid down, the reptiles flourished and then suddenly vanished from the earth.

The Era of Reptiles brought the most marvellous development of life that the world had yet seen.

The reptiles had begun at the end of the Age of Fishes to creep about the marshes and river banks with the amphibians. During the Mesozoic Era they grew so large and increased so fast that they became the ruling race.

Some of the reptiles were water creatures who swam in the ocean, and some flew in the air like clumsy birds, but the greatest of all walked about the land.

They had broad feet, with heavy bodies and tails, and leathery skin.

Many of the reptiles grew to be very large. Some were eighty feet long. Great lizards that swam in the water were over fifty feet. Flying reptiles with light hollow bones measured twenty feet between their wing tips. Besides growing very large, there were great numbers of them in sea and air and land.

THE FIN-BACKED REPTILE

Some lived on the trees and plants. Some ate the insects of the time. There were some that were meat-eating and preyed on other reptiles as the lions and tigers of today prey on other animals.

These flesh-eating reptiles were quicker moving than the others. Many of the others for protection grew horns on their heads; some developed pointed bony plates down their backs. One kind had a fin,

which branched out fan-shaped over its spine, making a terrifying appearance.

The reptiles had no hair. Their skin was smooth and fairly thick. There was nothing to protect them against the cold and they did not seem able to adapt themselves to it in any way. The climate must have been very mild and probably tropical.

The land swarmed with living things and the heat of a tropical climate was needed to produce enough food for so many tremendous creatures.

The reptiles' bones are found in great quantities in the fossil-bearing rocks. Some have been found with small stones between their ribs. These stones are supposed to have been eaten as an aid to digestion as canary birds and chickens eat sand and grit.

In America alone there were more than forty kinds of reptiles over fifty feet long. At present there are not more than six large reptiles known in the entire world, and most of these belong to the crocodile family.

There is one large species of crocodile in the Nile, two in India, and several in America. None of these are over thirty feet long. Great snakes are still found in South America and Asia.

Except for the crocodiles, the snakes, the turtles, the modern reptiles are nearly all small, quick-moving animals.

What happened to the great reptiles to kill them no one knows. The climate may have become much colder and frozen them, or it may have become much

drier and killed the rich tropical growth on which they fed. The ocean, perhaps, swept over the land, covering all but the highest mountains. The reptiles accustomed to living in fertile valleys could no longer exist, when crowded to the hills.

THE DOG-LIKE REPTILE

No picture of the large reptiles ever conveys the impression of their size as does the sight of a restored skeleton. In some of the large Natural History Museums throughout the world are found mounted specimens of these giants who browsed among the tree-tops and splashed through the lakes of the Mesozoic Era.

CHAPTER VIII

THE AGE OF THE THREE LAYERS

THE TRIASSIC AGE

The Age was called Triassic
And the reptiles then were seen.
They left two-feet foot prints on the sand
With a four-foot stride between.

They swam in all the waters,
And they flew about the trees.
They ate tons of tender grasses
And the branches of the trees.

They grew strange coats of armor,
And they reached enormous size,
But they lost the world's supremacy,
Which is nature's greatest prize.

THE AGE OF THE THREE LAYERS

The first period of the Reptile Era takes its name from Germany, where fifty years ago a German Professor discovered three layers of rocks that were deposited at this time. They were called the Trias, the Three Layers, and since then that name has been given to this Age.

During the Triassic Age there were eruptions of trap rock and lava along the Atlantic Coast from Nova Scotia to Carolina. Most of the trap rock was forced through cracks in the earth instead of through the craters of volcanoes.

The rocks that make the Palisades of the Hudson River were formed at this time. The trap rock of which they are made has long been known as the best road-building stone in the United States. The western bank of the Connecticut River Valley and Mount Tom are made of trap rock.

Some of the finest marble in the world was made in this period. Marble is limestone hardened by heat and pressure. The Carrara marbles used by the sculptors of Italy are limestones of the Triassic Age which have been hardened by the heat of nearby volcanoes.

The reptiles began to increase very fast in this age

and before its close had reached great size. They were cold-blooded creatures with very small brains. Some of the reptiles were large and some were small. Some were very slow and some quick and agile, but none were really intelligent.

The mammals (the warm-blooded animals) were beginning to develop. Insignificant little creatures

THE SWIFT-FOOTED REPTILE

that at first ran to holes in the ground for safety when the reptiles came near. These little animals had a taste for reptile eggs and they ate them whenever they got a chance.

The mammals perhaps started out in life on the mountain tops or on the seashore where an arctic current was washing in. At any rate, they found that to live they must be able to stand changes in temperature. So they developed a system that was warm-blooded instead of cold.

The young mammals were born like puppies and kittens. They looked like their parents and needed

only a few months of their mother's care before they were able to take their place in the world.

The reptiles were quite different. They laid their eggs in the sand or on the banks of streams where they were hatched out by the heat of the sun. The young

A Water Reptile

reptiles were left to themselves to grow up and swim in the streams or pad along with their soft feet on the damp marshes.

Many of the reptiles walked on two feet, their front legs being short and used only occasionally for support in walking.

Though they were not lizards, they looked more

like lizards than any other animal that is alive now. Lizards that walked on their hind feet and stood nearly erect with their long tails dragging behind. Short-legged lizards that ran about the ground. Lizards with heavy thick legs like a bear.

The water reptiles were many. Some looked like fish and some resembled water birds. They lived on fish and squids.

A Giant Fern

The fish had been the great race of the world before the reptiles came. Now the reptiles appeared on the river banks and in the seas. The fish became food for the water reptiles. They were no longer the ruling race.

The plants and trees of the earlier ages still grew on the land. Many of the trees in the Age of the Three Layers were like the trees of the coal forests. There were horsetail rushes and rushes with bamboo-like joints.

There were tropical plants much like the sago palm. There were forests of giant cone-bearing trees.

In Arizona there are great plains covered with the fallen trees of the Triassic Age. These trees fell and were covered with water that washed them down in the current and left them on the Arizona desert.

While they lay under water the fine colored clays and minerals soaked through them. The minerals absorbed the wood in the logs and turned them to stone.

There they lie on the Arizona desert, petrified logs. The shape of the tree and the rough bark are there as they were in life. The minerals that have soaked through them have colored them red and blue and yellow and brown. In the Triassic Age these trees stood erect and the reptiles walked in their shade.

CHAPTER IX

THE AGE OF THE JURA MOUNTAINS

THE JURASSIC AGE

The giant brontosaurus,
The spiny stegosaur,
The flying pterodactyl,
And the long-necked dinosaur,
They have disappeared forever,
That race grotesque and grand.
The Age was called Jurassic
When the reptiles ruled the land.

Perhaps the food grew scarcer,
Perhaps the air grew cold,
The continents were forming,
By changes manifold.
An inland sea in Europe
Laid down the layers of sand
That built the Jura Mountains
When the reptiles ruled the land.

THE AGE OF THE JURA MOUNTAINS

The age of the Jura Mountains was the time when the reptiles ruled the land with no one to dispute their supremacy. There were reptiles of all sizes, some as small as a tiny lizard of today, some giants thirty to eighty feet long. They wandered over the land, their little eyes glistening as they turned their heads from side to side looking for food.

There was the Brontosaurus with a body like a hippopotamus and a head like a giraffe. Sixty-five feet long and weighing thirty-seven tons. Imagine thirty-seven horses standing on a scale. They would only weigh half as much as this brontosaurus.

There was the Stegosaurus with a tiny head and a beak like a turtle. It was shaped like a half moon standing on four short heavy legs. Its tail was armed with thick spines. On its back grew two rows of triangular bony plates. It was bigger than an elephant.

There were dinosaurs of all kinds. Great plant-eating dinosaurs forty feet long and small dinosaurs the size of a rabbit. Dinosaurs with long necks that could stretch up to the tree tops to snap up a bird or reach down in the water and pull out a fish.

In the water great saurians twenty-five to fifty feet

long swam about, lashing out their tails and devouring all the fish they could reach.

Some reptiles had learned to fly, not the heavy giants who browsed on the tree-tops, but slender, agile ones with leathery bat-like wings.

THE GIANT BRONTOSAURUS

The flying reptiles were called Pterodactyls (ter-o-dac-tyls). They were four-footed creatures with hollow bones which made them very light. Some of these flying reptiles were no bigger than canaries. The wings of the largest ones measured twenty-five feet from tip to tip.

One flying reptile is named Rhamphorynchus

(ram-for-inkus). Its little finger grew along the top of its wings and reached all the way down to their tips. It had a hatchet-shaped head and sharp teeth. Its long thin tail ended in an arrow-like tip like the tail of the mythical dragon.

RHAMPHORYNCUS

It did not fly in the air as a bird flies. Instead, it darted from side to side like a bat, as it hunted for the small reptiles and insects on which it fed.

At this time another flying creature lived called Archeopteryx (arki-op-ter-icks).

Archeopteryx was one of the first birds. It had downy feathers on its body and its four legs were covered with down and tipped with quill feathers. It also had some teeth and a long bony tail. This bird lived by diving into the water for small fish or shell fish. Almost all the early birds were divers and lived near the water.

In the Arctic region today are found birds that are a little like those that lived in the Jurassic Age. These

Arctic birds even have roots of teeth like the teeth of Archeopteryx.

At the time these toothed and tailed birds lived, a very fine limestone was formed. It is the kind that is used now in making the best colored engravings. In

ARCHEOPTERYX

a piece of this fine limestone has been found a fossil of a bird about as large as a parrot. This bird was an Archeopteryx. The stone is so fine that it shows the marks of the feathers. The prints of the tiny teeth are there, and the long tail with twenty-two bones reaching to the tip.

While Rhamphorynchus the flying reptile was cold-blooded, Archeopteryx, the flying bird, was warm-blooded. All the modern birds are supposed to have descended from Archeopteryx or one of his kind.

But the cold-blooded Rhamphorynchus and all the powerful reptiles have died. No one knows the reason the large reptiles vanished leaving only the snakes, the crocodiles, the lizards and turtles to represent their great race.

The ocean washed over a great part of the land in the Jurassic Age. In it lived a mollusk with a shell like a snail. These mollusks were called Ammonites. Their shells were beautifully curved and fluted. Fossil ammonites are found everywhere in the Jurassic rocks, but none are alive today.

THE SPINY STEGOSAUR

The pearly nautilus is a relative of the ammonites. It lives only in warm water. So the climate was probably warm when the ammonites lived in the sea.

Many of the tropical trees that lived at this time were killed later. Their places were taken by other trees that could live in a cold climate.

It seems from this that the reptiles, the mollusks who died with them, and the tropical trees, all were killed by a change from warmth and dampness to a cold dry climate.

During the Age of the Jura Mountains a great deal of the land was under water. In America the ocean covered the land where the Great Salt Lake is now. An inland sea swept in from the coast of Canada. Parts of the Rocky Mountains were under water and the sea covered all Western Canada and probably Alaska.

The ocean in Europe came in from the North and swept over the land as far south as the Alps. The land where the French Alps are now was covered with sand carried there by the sea.

By the time the sea subsided the sand was many feet deep on the land. Later the sand turned to rock. In the earth changes the rock was crumbled and folded and pushed up into mountains.

These mountains are known as the Jura Mountains. It is from these mountains that the age was given its name—The Jurassic Age.

CHAPTER X

THE AGE OF CHALK

THE CRETACEOUS AGE

The chalk was laid down in the age called Cretaceous,
The reptiles were ending their lifetime voracious,
They were such a great size that they seemed to be brave,
And the little marsupials hid in the cave.

The great mountain ranges rose over the land,
The climate in Iceland was said to be bland.
The oaks and the laurel, the maples and birch,
Were leaving the mosses and ferns in the lurch.

The shallow seas spread where the nations now walk,
And left a deposit of greensand and chalk.
The shells of the mollusks in deep layers were laid,
And the chalk fields of France and of England were made.

THE AGE OF CHALK

The last age of the Reptile Era was called the Cretaceous Age, from the chalk which was deposited by the seas at that time. Creta is the Latin name for chalk.

In the seas of the Chalk Age were great swimming lizards called Mosasaurs. They were covered with scales and their feet were like flippers. They swam in the shallow water along the coast, and grew as long as fifty feet.

THE TYRANT DINOSAUR

On land the Tyrant Dinosaur was the fierce and terrible king of the reptiles. Forty-seven feet long from head to the tip of its tail, it walked on its hind legs and was twenty feet tall. Its short front feet had powerful claws and its large mouth was lined with strong teeth. Heavy as an elephant yet strong and agile, it was the terror of the forests and the plains.

The shells of the turtles are found in the fossil rocks of this age. They grew very large, some measuring twelve feet across. The turtles are among the few reptile families that have lived on to the present time. Their hard back and their armor-like shell into which they can withdraw when attacked have been a protection to them through the ages.

A dinosaur who survived until the beginning of the Age of Mammals was the Triceratops. Tri-cera means three horns. It was a reptile like a rhinoceros with three horns, two on the top of its head and one on the end of its nose. It had a beak like a parrot and a ruffled cape of bone reaching over the back of its neck. The length from the tip of its nose to the end of its shoulder cape was seven feet. Triceratops himself was three times longer than his cape.

While the reptiles were growing very large and occupying the entire world, another kind of animal had been creeping about in sheltered places where there was no danger of attack.

There were the marsupials to whose family belong the kangaroo and opossum. Like the reptiles they walked erect on their hind feet when they chose. Un-

like the reptiles who laid their eggs on the sand and left their young to shift for themselves, the marsupials cared for their young ones. As soon as they were born they carried them around in a pocket-shaped pouch over their stomachs.

Except for the pouch the marsupials were very like the mammals we know today. When the modern animals came they crowded most of the marsupials off into remote corners of the world.

THE THREE-HORNED TRICERATOPS

As the reptiles walked on the seashore or the river banks looking for food their foot-prints were left in the damp ground. These tracks hardened in the sun and were filled in later by sand or mud. The mud dried and became a rock enclosing the foot-print. Thus leaving fossil foot-prints of the reptiles in the rocks.

In New Jersey recently workmen were digging in a bed of clay and found some dinosaur's foot-prints three feet long. They were perfectly preserved. The workmen called them chicken's feet and destroyed

three of the foot-prints. A man who was interested in fossils happened to pass by just in time to save the fourth from destruction. He had it cut out of the clay in a large slab and sent it to the State College Museum in New Brunswick. There they found it was the foot-print of a large dinosaur that lived during the Age of Chalk.

For some time men have been hunting in Asia for fossils of the distant ages. In a bed of clay and gravel in a desert in the center of Asia they found large eggs that had turned to stone. They are the eggs of a dinosaur laid millions of years ago.

These eggs were six inches long and three inches wide. They have been flattened by the weight of the earth resting on them, but the shells are still whole. Protected by their thick shells and the sands of the Gobi Desert these Dinosaur's eggs lasted for millions of years.

While they have lain there covered by the desert sand, races have vanished and mountains crumbled to earth. Now the eggs are kept in the museums of the world to show what kind of creatures roamed over the Earth in the Era of Reptiles.

Vast chalk deposits were made in the Cretaceous Age. At that time parts of the center of the continents were swept over by shallow seas. The seas were filled with tiny mollusks and other creatures, whose crushed shells were spread on the land in layers hundreds of feet thick. There they hardened and turned to chalk.

These chalk-bearing seas spread over the interior

plains leaving chalk deposits wherever they went. The chalk cliffs of England, which gave England the name of Albion (white) are well known. France has the same chalk cliffs in her Northern districts. There are great chalk beds in the middle of the United States and Russia. Wherever the seas of the Cretaceous Age spread over the land innumerable little creatures lived and died, leaving their shells to build up the great chalk deposits.

THE SWIMMING MOSASAUR

Besides the chalk the oceans also laid down layers of greensand which were spread over the land covered by the sea. The greensand was made of material washed into the ocean by the rivers. Little shells like those in the chalk were mixed with this sand and being absorbed in it gave it a greenish tone.

The climate was very mild. The same trees lived in the Arctic circle that grew in Virginia. And the leaves of all the modern trees are found as fossils in the rocks.

The oak and sassafras, maple, beech and birch, all trees that lose their leaves in winter, were growing then. The great mosses and tree-ferns and the huge horsetail rushes disappeared and in their place came palms and grasses.

The reptiles were dying off at the end of the chalk age. Modern forms of crocodiles were then living, as well as snakes, turtles and lizards. The great reptiles disappeared and left the world to the mammals who became the leading race of the early modern times.

CHAPTER XI

THE ERA OF MAMMALS

THE CENOZOIC AGE

As the Recent Age advances
The reptile hordes have gone.
The mammals now are ruling
And man comes creeping on.

The glaciers slowly gather,
Increase and melt away.
The giant mammals vanish
And man begins his day.

THE ERA OF MAMMALS

The Cenozoic Era means the Era of Recent Life. It is also called the Age of Mammals. The warm-blooded mammals had been small and timid during the Reptile Age. Some unknown reason caused the reptile race to disappear. At once the small mammals finding they were free from attacks of the reptiles, began to increase and grow larger.

In the first part of the Era of Mammals there were only a few animals that looked like those that are living today. So it was called the Eocene Period, the Dawn of Modern Life.

Centuries later a few more of the modern animal families were living and that time was known as the Miocene Period. Then came the Pliocene Period when the animals were nearly the same as they are today. Many, though, were much larger and others had curious horns and tusks.

After that the Glacial Age began and many animals were killed by the cold. Those that were left are mainly the kinds that are living now. So the Glacial Age was also called the Pleistocene Age, which means, Most of the Modern Life.

In the days when the study of the rocks first began, the geologist divided the time into four parts. The

Age of Fishes was called the first; the Age of Reptiles the second; the Age of Mammals the third; and the Age of Man the fourth. The name of the other ages have been changed, but the Age of Mammals is still called the Tertiary (third), and the Age of Man, the Quaternary (fourth).

At the beginning of the Cenozoic Era the trees were of the same kind that are growing today. The insects were of the same families, though some kinds have become extinct.

Many species that lived then have changed. The oysters have grown smaller. Remains have been found of oysters that were thirteen inches long and six inches thick. A fried oyster of that size would rival a fried chicken.

The marsupials slowly disappeared, crowded out by the modern animals. The opossum still lives in North America. There are a few marsupials left in South America.

But in Australia the Kangaroo still jumps through the bush and the Duckbills burrow in the ground. The Tasmanian wolf wanders through the forests and the Phalangers fly about the trees. They are safe in their island home, unless the domestic animals man brings with him should take their place and drive them out of existence.

The continents now are practically the same shape as they were at the beginning of the Era. They are being added to or washed away by the sea about the coast line.

The seas have washed over parts of the land many times during the Era of Recent Life, but its outlines have been little changed. The land is being altered by the work of the rains, the rivers, the winds, and the tides.

A Marsupial Mother

The rivers, cutting their way down to the sea level, have changed the surface of the land in many ways. The river works back and back, collecting creeks and brooks and rills as the raindrops collect each other on a window pane. The head waters of the river cut their way back and reach out to other springs and water sheds besides those from which they rise. When a stream taps another and draws it off to its own system, it is said to behead that river. Many of the valleys of the country have been altered by this process of beheading a neighboring river.

The greatest work in altering the surface of the land in recent times has been done by the ice in the different glacial periods. Earthquakes and volcanoes are still doing their part, and the coral polyps are building and enlarging islands in the clear shallow seas.

In the land around the western shores of the Gulf of Mexico are petroleum fields made in the Cenozoic Era. The California oil wells are of this time. In Russia the rich Baku oil fields around the Caspian Sea were made then.

The oil collects where thousands of plants or animals decay under sea water. The fat in their bodies turns to oil. When sea water is clear and in motion, the currents carry the oil away and it is lost. If the sea water is muddy and still, the oil mixes with the clay and sinks to the bottom. In time the clay turns to rock, and the oil is held in it.

Though oil had been known to the ancient people of Europe and Asia, it was thought worthless when it was first found in this country. Men were drilling for salt mines in Pennsylvania and suddenly the oil came gushing out of the well. The miners let the oil run away on the surface of the Kanawha River. So much oil floated away before its value was discovered that the river was nicknamed Old Greasy.

A great deal of oil is also found in the rocks of the time of the Age of Fishes. The bodies of the little plants and shell fish turned to oil then and were stored

away to light the lamps and drive the motors of the world today.

Asphalt is a very thick form of petroleum and tar. There are two famous asphalt lakes, one in Trinidad and one in Los Angeles. In these sticky lakes are found the bones of ancient animals that have wandered in and died there.

AN EARLY MAMMAL

The La Brea Pool at Los Angeles is noted for the skeletons of the animals and insects that have been found mired in the lake. There are the bones of camels and bison and mastodon. No animals like these live in California now.

The reptiles, except for a very few, had disappeared before the beginning of the Recent Age. The mammals who took their place had larger brains and greater intelligence. They also protected their young as the reptiles had never done.

The mother mammals nursed the young ones, giving them milk as a cow nurses its calf. They kept them with them while they were little. After a few weeks or months, the little mammal could eat the same things

as its parents. The mother then gave it a few lessons on how to care for itself and where to find food.

It was in caring for their young that the animals began to develop something like the soul of the man. The parents fought for the helpless young things that were with them, brought them food even when hungry themselves, and protected them from harm. So the Cenozoic Era brought with it the beginning of the soul.

CHAPTER XII

THE DAWN OF MODERN LIFE

THE EOCENE AGE

The dawn of the Recent, the Eocene,
The animals lived on the grasses green,
The little horse with its tiny toes,
No trace of its future grandeur shows.
The whales and porpoises seem to be,
Warm-blooded animals gone to sea.

The reptiles had laid their eggs on the shore,
The fish were the parents of hundreds more,
The birds did better and built a nest,
But the animals cared for their young the best.
And the work of the Eocene Age began
Preparing the world for the Age of Man.

THE DAWN OF MODERN LIFE

This period, the dawn of modern life, brought a great change over the land. The grasses which had begun to grow during the Age of Chalk now covered the marshes where the mosses used to be. The inland seas that receded had left at some places inland lakes. At others broad meadows marked the spots where they had been. On these meadows, grasses grew and spread on up to the tops of the mountains.

The great forests of the Age of Fishes had no honey-bearing flowers to attract bees and other insects. It was in the Age of Chalk that flowers began to be seen. When the Eocene Age commenced, laurel, dogwood and magnolias were growing in the forests. The rose family grew in the open spaces and the water lilies in the streams.

The trees were like modern trees, palms and evergreens in the tropical regions; oaks, maples, beeches and other trees that lose their leaves in the winter, in the cooler places.

The mammals were walking about the land. Some ate grasses and tree branches. Some ate other animals. The ones that ate grasses had toes that were gradually turning to hoofs. The animals that lived on other animals had paws and claws.

The mammals were still very strange compared with those of later times but they were not nearly as odd as the reptiles had been. The birds were like the birds of today. They lived on the berries and the fruit and the seeds of the grasses and the worms and insects.

The large reptiles that walked about grazing on the tree tops and branches had died. The modern reptiles are mere pygmies compared to the great reptiles of the Mesozoic Age. The turtles and lizards and alligators have short legs and creep along the ground. The snakes have no legs at all.

PATRIOFELIS

Back in the rocks of the Eocene period are found the bones of the first horses. Unlike the modern horse, they were dainty little things about two feet long with five toes instead of hoofs.

The remains of camels and pigs and monkeys are found. All are small like the early horse, but as time went on they grew larger until they reached their present size.

Another animal of this time was called Patriofelis (the father of cats). It belonged to the family of the flesh-eating animals such as leopards, lions and tigers.

Besides the cat family there was also the family of the rodents, parents of the rats and mice and other gnawing creatures. There were squirrels and rabbits. One great rodent was as large as a calf.

A very large animal that lived then was the Titanothere, or giant beast. In the early part of the Era of Mammals it was small. Later on the Titanotheres grew to the size of a small elephant. Clumsy, heavy creatures, their brains were no larger than a man's fist.

THE GREAT TITANOTHERE

America was then the home of the rhinoceros. It was small at first but grew larger than any in Africa today. Yet there is not a rhinoceros left in America now. All that are living are found in Asia and Africa.

In the oceans of the Eocene Age was a shell fish called Nummulite. It had a spiral shell about the size and shape of a coin. The nummulites increased very fast, crowding the seas with their great numbers. As the seas dried up these nummulites were left in masses

on the beach. Because of the lime in their shells the stone which was formed by these mollusks is called nummulitic limestone. This is one of the very finest limestones. It was used to build the pyramids of Egypt.

Whales and porpoises swam in the Eocene Seas. They are not fish, but mammals that left the land to live in the water. They breathe air as the land animals do.

THE WHALE THAT WENT TO SEA

The fish lay eggs in the streams or on the edges of the land. The whales and porpoises are like the mammals in the way they raise their young. They are warm blooded and they nurse their offspring. Wading about the beaches they found it easier to find food in the water than on land. In the sea their clumsy feet changed to fins and flippers. Once having taken to the water they stayed there.

The seal is another mammal that lives partly in the water. In spite of the seal's fish-like tail and fin-like flippers it is not a fish. It barks and can be taught simple tricks. In many ways it is like a dog.

The history of these animals show that there is a constant change in the life on the earth. Some of the

creatures finding themselves forced to live in a new place managed to fit their habits to it successfully. Others in the same place, because of some unknown reason, failed and perished.

In every case those who live through any change in climate or place are the ones who have best adapted themselves to the new conditions.

CHAPTER XIII

SOME OF THE MODERN ANIMALS

THE MIOCENE AGE

The Miocene stage of the Tertiary Age
Was the Arctic's tropical day
When from Asia across to the home of the Norse
There was dry land all the way.

The tall evergreen in the Age Miocene
Flourished on Greenland's shore.
The grasses and palms with their waving arms,
The fruits of the tropics bore.

The fox and deer and the camel queer,
And the mastodon passed that way,
The bear and the horse and the cats of course,
And other beasts of prey.

They left their bones in the ancient stones,
To tell of their travels wide.
And there they are found far under the ground,
In the sands that were petrified.

SOME OF THE MODERN ANIMALS

In the Miocene Age the continents of Asia, Europe and North America were all connected by land. The climate was warm. Southern firs and palm trees grew as far north as Alaska and Greenland.

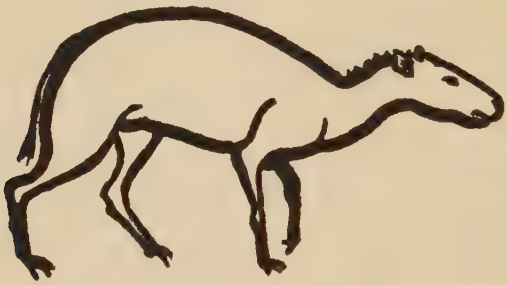
There were many animals in the world. As they increased in numbers they began to rove about looking for more food and new country. They found their way to the bridges of land connecting the continents and wandered across them, stopping to feed on the grasses and branches as they went.

THE LITTLE CAMEL

As the horse and camel trotted across the land bridge between America, Europe and Asia, they passed the mastodon, the ox and the deer. For many years herds of mastodon roamed over North and South

America, as well as the camels, the deer and the horses. After the great ice age the mastodon and the camels disappeared from America. The camels whose bones are found everywhere in the rocks of that time are now brought in to this country from Africa and exhibited as strange and rare creatures.

As the grazing animals moved from place to place, they were followed by the flesh-eating animals—the bears, the wolves and the saber-toothed tigers. These flesh-eating animals were looking for food and only the swiftest and cleverest of the grazing animals could escape them.



THE DAWN HORSE

The feet of the grazing animals hardened into hoofs so they could run faster. They learned to move about in groups. The groups were guarded by leaders who kept a lookout for danger while the rest of the herd fed.

The horse became so quick of hearing and so fleet-footed that not even the most tireless animals could catch him. The deer were also swift runners. The oxen moved in great herds that stampeded at the com-

mand of their leader. The tusks of the elephants and their great strength made them the lords of the forest.

Wild pigs and tapirs lived in the marshes by the river banks. They had very thick hides and were very large. The turtles were large. The shell of one has been found that was six feet long. This turtle, when walking, measured twelve feet from the tip of its head to the end of its tail.

There were many whales in the Gulf of Mexico which, at that time, was so large that it covered the State of Alabama. This arm of the Gulf must have been shut off from the open ocean. The whales were left to die on dry land or in shallow water.

Many skeletons of these whales have been found in Alabama and the farmers have ploughed up so many of their three-cornered back bones that they use them for fences.

At this time pine trees grew on the shore of the Baltic Sea and from their branches trickled a gum called amber. This gum, dropping from the trees, was caught in the water or the sand and preserved through the ages. Large pieces of it are found in the beds of clay by the Baltic Sea, hardened but clear as the day it oozed from the pines. Often the sea washes up on the sand blocks of amber from the Miocene forests.

Sometimes insects flying about were caught in the sticky gum and imprisoned in it. So the fly in the amber tells the tale of the different insects that lived at that time.

In the sandbanks at the outlets of the lakes of the Miocene Age are found layers of dried leaves and insects. They fell in the water and were blown ashore by the wind. Some of these layers are nearly two feet thick. They often contain hundreds of different sorts of beetles, ants and flies, most of which are like the insects of today.

While the mammals were wandering about the world, the birds had grown to be very like those of the present time. Many of the bones of the large birds have been found as fossils in the rocks. There were owls, parrots, flamingoes, pheasants and vultures, waterfowl and ostrich-like birds. Some were more than ten feet high.

So the Miocene Age in which lived the families of some of the modern animals, came to an end and the Pliocene Age, which contained more of the recent life began.

CHAPTER XIV

MORE OF THE MODERN ANIMALS

THE PLIOCENE AGE

The last Age of the Tertiary
Is called the Pliocene;
The animals were ruling then,
The land was warm and green.

The mastodon and monkeys both
Had spread about the land.
The armadillo and the sloth
Were very strange and grand.

The Rocky Mountains and the Alps
Were rising from the plain.
The lava from the crater's mouth
Fell like a fiery rain.

Then slowly on the highest peaks,
The ice began to form,
And as the creatures hurried south,
The Glacial Age was born.

MORE OF THE MODERN ANIMALS

At the beginning of the Pliocene Age the Alps and the Rocky Mountains were gradually rising to their present heights. The old land wrinkles had been pushed up into mountain ranges, washed down by the rains and rivers and then covered by the deposits of the ocean when the land sank below the sea level.

This had happened many times through the ages. The mountain ranges were now broad plateaus. Volcanoes in the Rockies spread thick fields of lava and ashes over the western land. The upheaval that caused the volcanoes pushed the Rocky Mountains up to greater heights.

Where the Yellowstone Park is now, fifteen forests grew and were smothered with ashes. Each new forest took root on the pile of ashes that covered the one beneath. In some places where the wind and water have cut into the side of the canyon the forests can be seen, standing one on top of another. The trees have turned to stone and the ashes to rock. There they wait until the rain and the river, the wind and the weather cut them out of the cliffs and bring them back to view.

At this time the Alps were formed by the land near the Mediterranean crumpling and pushing north against the old plateaus in France and Germany. The

Himalaya Mountains are a branch of the same system as the Alps and were formed at that time. The Andes Mountains in South America are a continuation of the Rocky Mountains.

As these mountains grew higher the rivers grew swifter and carried down to the plains quantities of earth washed from the mountain sides. In the valleys the rivers broadened out into lakes.

Most of these lakes had outlets to the ocean and gradually they drained off and disappeared. Some of them, like the Dead Sea, lost their outlet rivers by

THE ARMADILLO

changes in the level of the land. The fresh water that flows into these lakes evaporates and the salt is never carried off. They are more salt than the ocean and so buoyant that a man in swimming cannot sink.

While the mountain ranges were growing to their present form the animals from all parts of the world were moving from place to place.

In South America the ant-eater, the armadillo and the sloths had developed. They were a strange group and nothing like them was found in any other corner of the globe. For many years South America had been an island. The animals there were separated

from their kind on the mainland. Undisturbed in the tropical forests many odd forms grew and thrived.

During the Pliocene Age the Isthmus of Panama rose out of the water and formed a bridge between North and South America. Across this bridge the animals wandered back and forth.

In North America were horses, mastodons, deer, llamas, tapirs and cats. Though the animals from North America could live in the south, none of the South American animals seemed able to live in North America. The sloths and ant-eaters gained a foothold for a time but soon disappeared.

THE MASTODON

Perhaps the coming ice age drove them back before they were really at home in the north.

At the beginning of the Pliocene Age the horse had become a full grown modern horse. It had hoofs now instead of five toes and weighed half a ton. The little five-toed horse had been growing and using its central toe for walking until the extra toes disappeared from want of use.

The single toe hardened into a hoof of horn. With this tough hoof the horse could travel long distances and run very fast over rocks and tough grasses.

There were large grass-covered plains at this time. The horses roamed from one place to another watched over by the leader of the herd. When attacked or frightened they ran in groups to safety. When food was scarce they moved to some place where there was plenty.

In the rocks of the Pliocene Age are found fossil prints of grains like wheat, oats and corn. They were not quite the same as they are today, but so nearly like that it is easy to recognize them.

These were food for the horse and other grazing animals. The hippopotamus was one of these; the bison and the tapir were others. In Europe the giraffe browsed on the tree tops. There were many animals living north of the Mediterranean then that now are only found in Africa.

The insects then were very like the modern ones around us. The families of the rats, weasels and squirrels were almost the same as they are now.

The deer and buffalo at first had no horns. Their heads were as smooth as a dog's. It was in the Pliocene Age that they began to grow horns and antlers. The earliest fossils of them found in the rocks show no horns. Centuries later the horns began to grow. The deer's first horns were single, then they became double and at last they had full branched antlers.

In Africa and Southern Europe were the rhinoceros, the hippopotamus and the monkey. Some scientists think that the monkey family was the nearest relative to the family of man. They are always look-

ing for the ancestor that may have left descendants, one branch of which rose up rapidly to the highest scale and became man.

As man looks more like the monkey than any other animal they continue to search for the common ancestor who is called the missing link. The family of the horse can be traced back to the Eocene Age and even farther back into the Age of Chalk. But at present the ancestors of man cannot be definitely traced beyond the Glacial Age, the age that follows the Pliocene.

CHAPTER XV

THE GLACIAL AGE

THE PLEISTOCENE AGE

In the Pleistocene Age when the glaciers came,
The north was all covered with snow,
The mammals were then at the height of their fame,
It was thousands of years ago.

The great sheets of ice swept down over the plains,
In rivers of blue white snow.
And they carried the gravel that made the moraines
In their progress relentless and slow.

The tropics were chilled by the wind from the ice,
And the plants barely managed to grow.
Where the animals gathered from mammoths to mice,
Out of reach of the frost and snow.

The ice age had passed and the climate grew mild,
And the animals started to go,
To the north where the drift of the glaciers was piled,
And they stayed there an eon or so.

And four times the ice swept down over the loam
And then melted, the records show,
And four times the animals followed it home,
To the country they left long ago.

THE GLACIAL AGE

At the beginning of the Glacial Age the land about the mountains was pushed up into high plateaus by movements in the inside of the Earth.

As the land became high snow covered the tops of the mountains. The melting snow fed the mountain brooks. They became freshets during the rainy season and carried sand and gravel down to the plains below.

For a time as the land grew higher, the rain and rivers washed the loose soil away, leaving bare peaks on the highest mountains.

Later the snow began to fall faster than it could melt. The beds of the streams were filled with snow and the sides of the mountains were covered with it. More snow fell on the mountain tops and pushed that already in the stream bed farther down.

The snow next the earth melted and turned to ice. The pressure of the snow on the mountains behind kept the ice and snow in the stream bed moving towards the valley.

All the air was chilled. The new snow that fell melted less and less. Finally the mountains and hills and the plains were covered with ice. This ice kept moving slowly down the valley pushed on by the mass of new fallen snow behind it.

Animals that had been living far to the north were driven south in search of food and warmth. Plants and trees were killed by the cold. Only those plants whose seeds were carried to warmer countries by the birds and other animals were able to survive.

The Glacial Age was the last age of the greatness of the mammals. After that the change in climate and the coming of man reduced them in size and numbers.

THE MAMMOTH

In the early Pleistocene times the mammals became very large just as the reptiles had before their decline. The horse was much larger than any known today. There are remains of two families of elephants, the mastodon and the mammoth. These lived in America, as well as in Europe, Asia and Africa. The mammoth and the mastodon were as large as the elephants today. The mastodon lived in semi-tropical and temperate zones. The mammoth had a heavy covering of wool and long hair. It lived in the cold northern parts

of America, Europe and Asia. Perfect specimens have been found frozen in the ice in Siberia, preserved through thousands of years just as they were when they were frozen there.

Other gigantic animals were the musk ox, the reindeer, the hippopotamus, the rhinoceros and the saber-toothed tiger. None of their descendants today are as large as those that lived in the Glacial Age.

The cold and the scarcity of food during the time the country was covered with ice may have reduced their size. Just as the shaggy little Scotch ponies of the barren highlands are much smaller than the great well-fed draft horses of Belgium.

THE SABER-TOOTHED TIGER

The original horse which was a native of North America had migrated to Europe. Then those left in America disappeared. The Spaniards coming to Mexico in search of gold brought horses with them. That is the way that the horse came back to the Western hemisphere.

The saber-toothed tiger came from Europe to

North America. It went down to South America and then disappeared from this continent.

The animals were driven south by the great ice sheets that spread down from the north. The Arctic animals came down in front of the ice and drove the animals from the temperate zone ahead of them into the tropics. The tropical animals were crowded together farther South.

The great glaciers in Canada spread down into the northern part of the United States. In Europe a glacier from Norway and Sweden covered all northern Europe, and smaller glaciers spread out from the Alps.

The mountains of India were covered with snow and most of Siberia lay under the ice. From all the highest peaks of the Andes and the Rocky Mountains the glaciers came down into the valleys.

It is not known what was the cause of the ice. The plateaus of the continents at that time were a thousand feet higher than they are today. This would make the climate colder and gradually the ice would accumulate. Some think there was more rain or snow. Some think the climate was dryer and the sun shut off by cloudy weather.

Whatever the cause was the snow lay deep on the mountains. The weight from the top pushed the outer edges down the slopes.

It moved very slowly like snow slipping gradually down a roof. As it passed over the steep slopes and was pinched in the narrow valleys, deep cracks called crevasses were made in the smooth surface. Down

these crevasses trickled the water from the ice on the top, melted by the heat of the sun. The water cut a deep channel below the snow, escaping as a river from under the ice at the glacier's foot.

As the ice pushed its way down it scraped against the sides of the mountain ravines and carried away earth, gravel and even large rocks. Some of these

SNOW ON THE MOUNTAINS

were carried along on the ice until a projecting ridge scraped them off. Some were carried all the way to the foot of the glacier and there fell to the ground as the ice melted.

The boulders and gravel left along the sides of the glaciers are called moraines. The part that was carried to the foot is called the terminal moraine. The moraines and other materials carried by the glacier are called drift. All the land that lay under the glaciers is more or less covered with this drift. It is made up

of earth and gravel and boulders picked up far away and carried on the ice. It was left at the sides, or dropped at the foot of the glaciers as the ice melted. In places this drift gathered from all parts of the country is several hundred feet thick.

During the Pleistocene Age the glaciers pushed down into the valleys and melted away again four times. Each time the climate became warm, the glaciers melted and the animals and plants moved back

THE WOOLLY RHINOCEROS

again. So on top of each layer of drift are found the remains of plants and animals that lived there before the coming of the next ice age. Even peat bogs are found, showing that the glaciers were absent long enough to allow time for the slow growth of peat.

In the warm weather, after the last advance of the glaciers, the melting ice broke up into icebergs. These bergs floated down the rivers carrying on their tops rocks and gravel from the glaciers. The ice melted and the boulders fell on the river bed below.

In many places rocks are found balanced on other

rocks. They look as if they could be pushed over by a touch of the hand. These rocks were left in this position when the ice melted. The mountain side from which they came can often be found many miles away.

Glaciers starting on the hillsides of the mountains carried away the loose rocks and gravel. At the foot of the mountain the glacier met another and joined it. The lines of gravel on their sides joined also and were carried down the center of the ice river. In this way the rocks travelled until they reached a rolling country covered with many hills. These rounded hills were the terminal moraines of the older glaciers. There the ice dropped its load of dust and rocks and gravel as it melted into cream-colored rivers in the heat of the sun.

In the rich wet soil by the rivers little Alpine plants began to spring up. These soon found it too warm and moved north after the receding ice. Fir trees and trees that lose their leaves in winter left the tropics and followed them. After that came the animals who had been driven away by the cold.

There was the bear and the fox and the beaver and the mink and the muskrat. After them came the birds, the musk ox that now lives in the Arctic regions and the reindeer. The horse of the North, the elk and the saber-toothed tiger, and the mammoth covered with its coat of wool and long hair.

One day in the midst of them appeared a stranger, a creature that walked erect on two feet, with long arms with which he could reach and pick up anything he wished for. This was man.

The animals were all afraid of him. Besides his strange way of walking there was something about him that made him more clever than they.

For one thing he could break a branch from a tree, pull off the leaves and swing it about, hitting anything in reach. This frightened the animals. Their master had come.

THE GIANT DEER

Man thought things over, reasoned them out. He invented new ways of doing things and made tools to help his work. The days when the animals wandered unchecked about the world were over and the Age of Man began.

The ice of the Glacial Age melted slowly away. The great animals grew smaller and smaller and the Man with his hands and brain became the ruler of the world.

THE END

20-1481